13th IWA Specialized Conference on Small Water and Wastewater Systems
Athens, 14.-17.9.2016

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Efficient biogas production with small WWTP including co-fermentation

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Independent Consulting and Planning Engineers for Water, Wastewater, Solid Waste and Environmental Protection Technology Worldwide

Experience from the planning and realization of more than 1,500 projects in the field of environmental protection in the last 35 years

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Fields of specialization

Environmental Protection

Industrial wastewater

Municipal wastewater

Sewerage Systems

Water supply

Cost and fee calculation

Biogas-Project

Solid waste treatment

Plant operation

Project management

Turn-Key-Projects

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Environmental Protection

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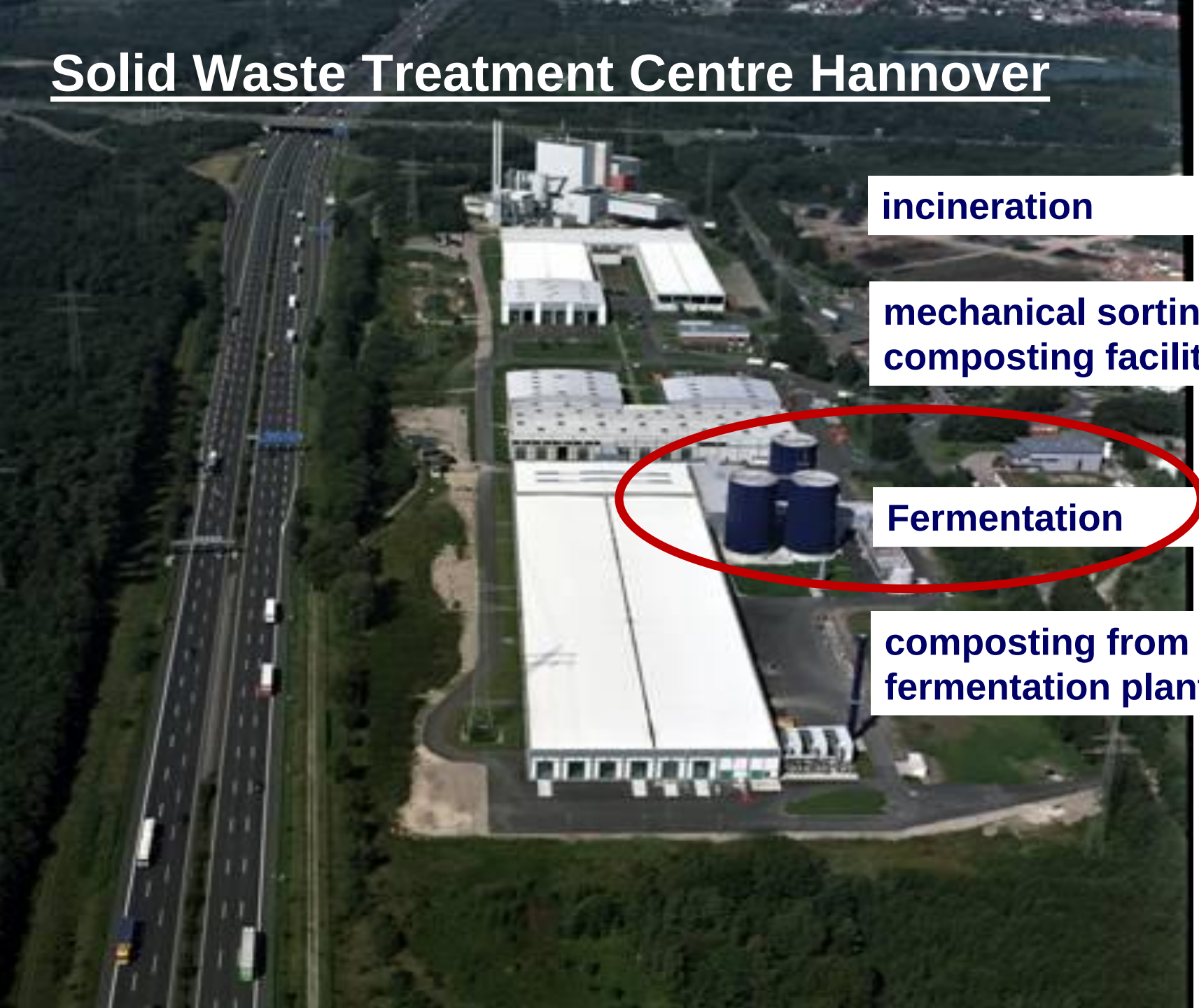
Turn-Key-Projects

University of Hannover

Solid Waste Treatment Centre Hannover




WWTP Zarrentin
80.000 PE
Digestor

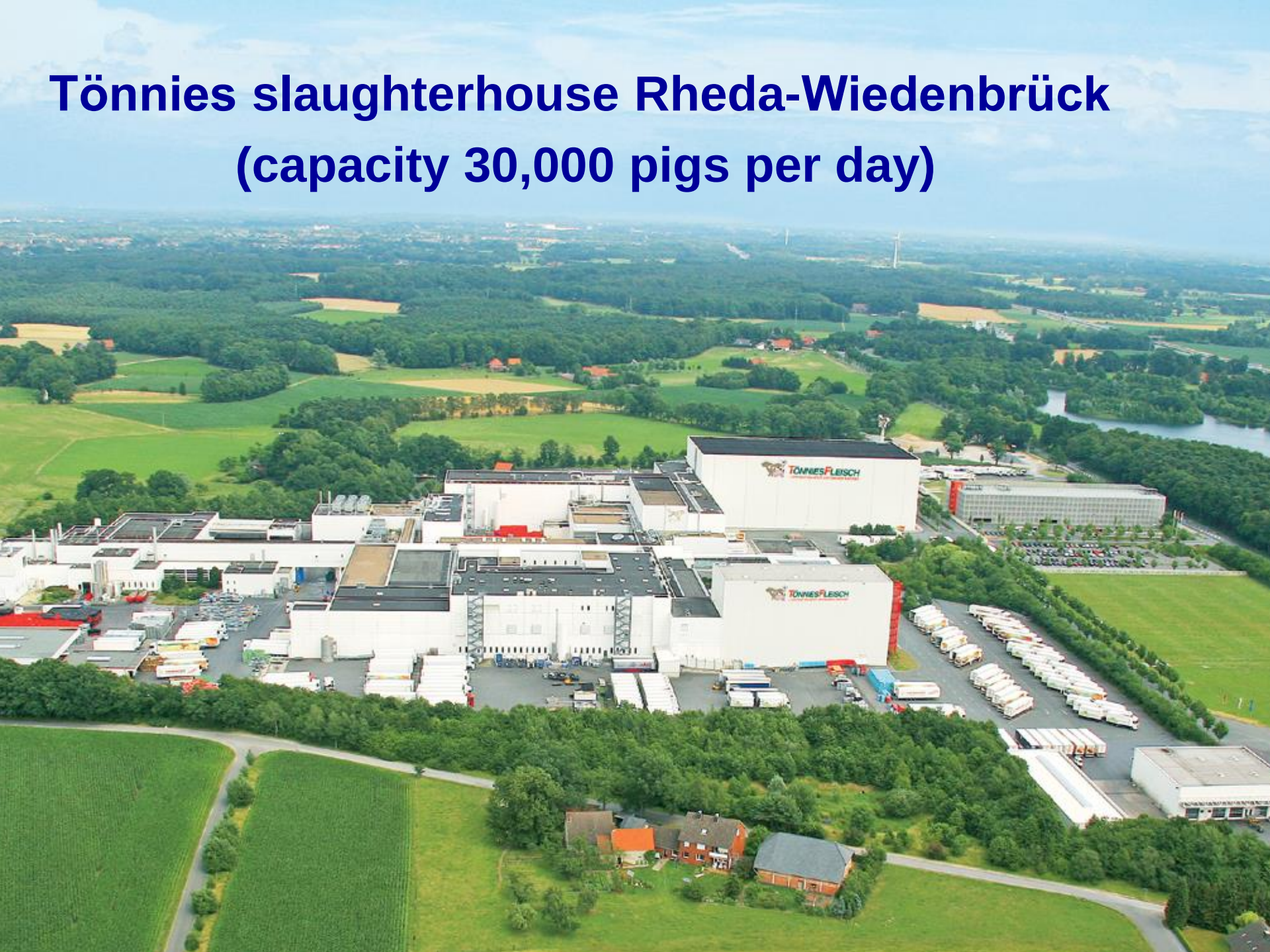
WWTP Zarrentin

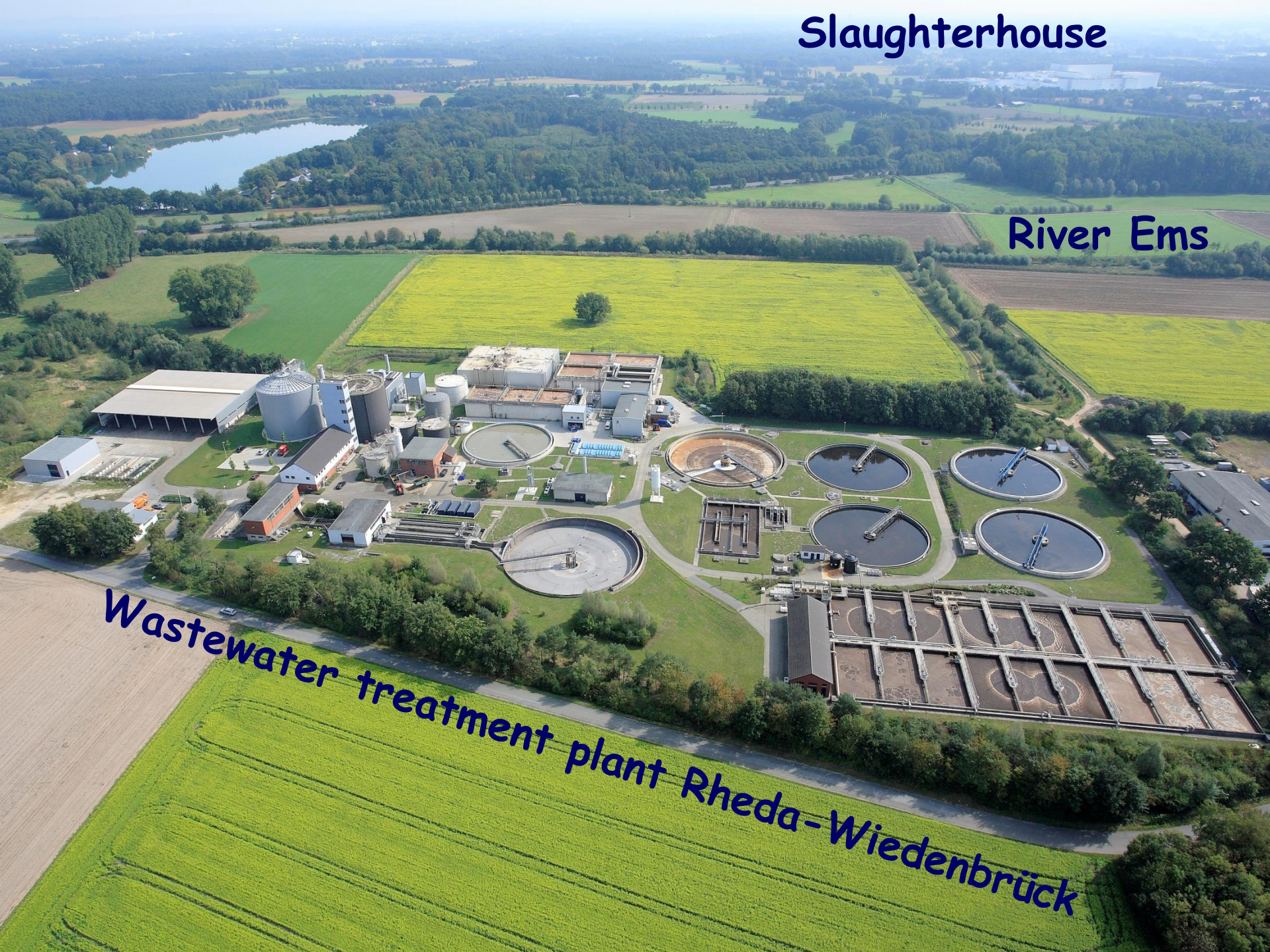
80.000 PE

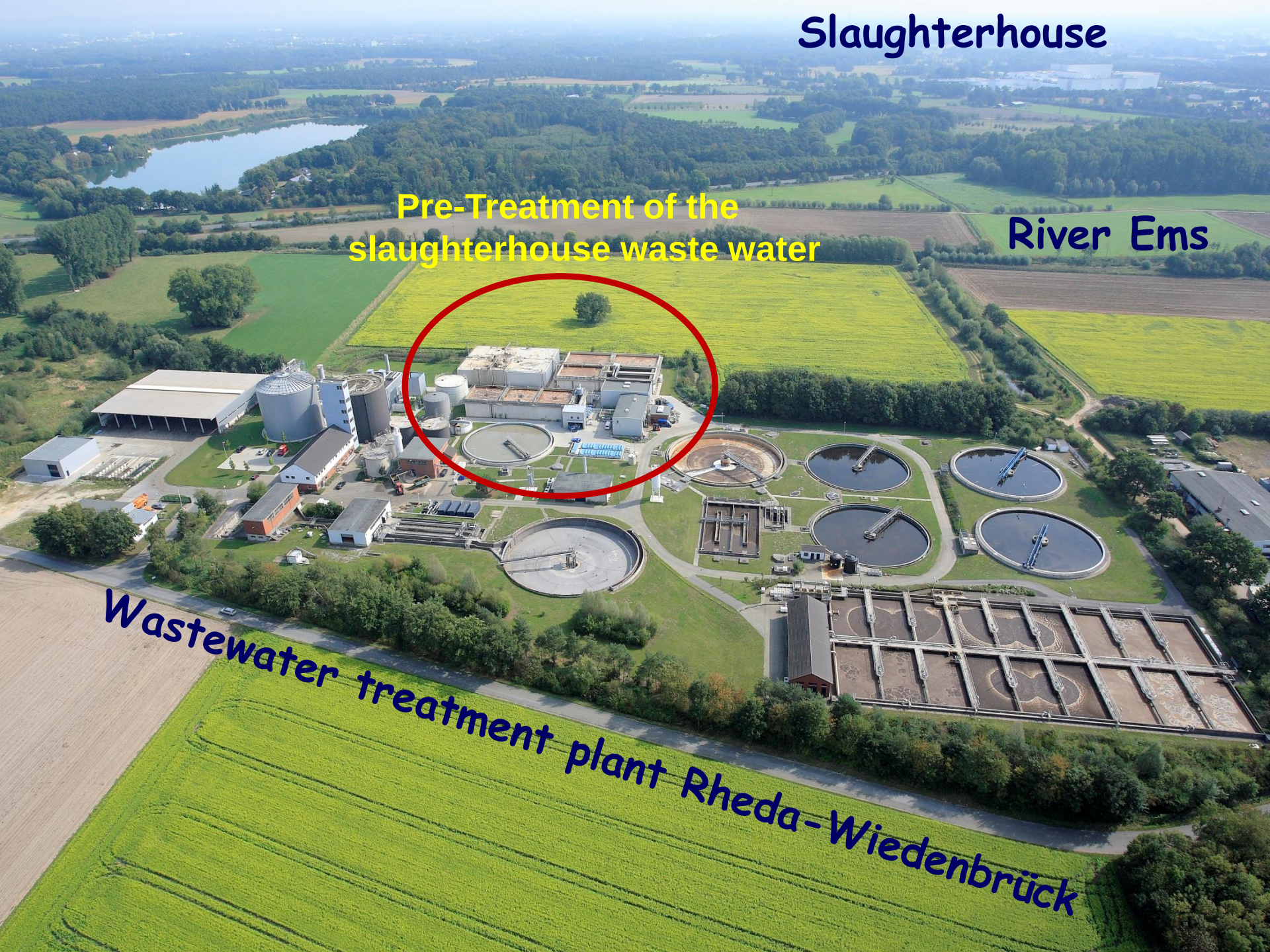
Digestor


WWTP Zarrentin
80.000 PE
Digestor
More Biogas from
sewage sludge
+ co-subtrate
1,0 – 2,5
m³ gas/ m³ reactor/ d

Tönnies slaughterhouse Rheda-Wiedenbrück (capacity 30,000 pigs per day)

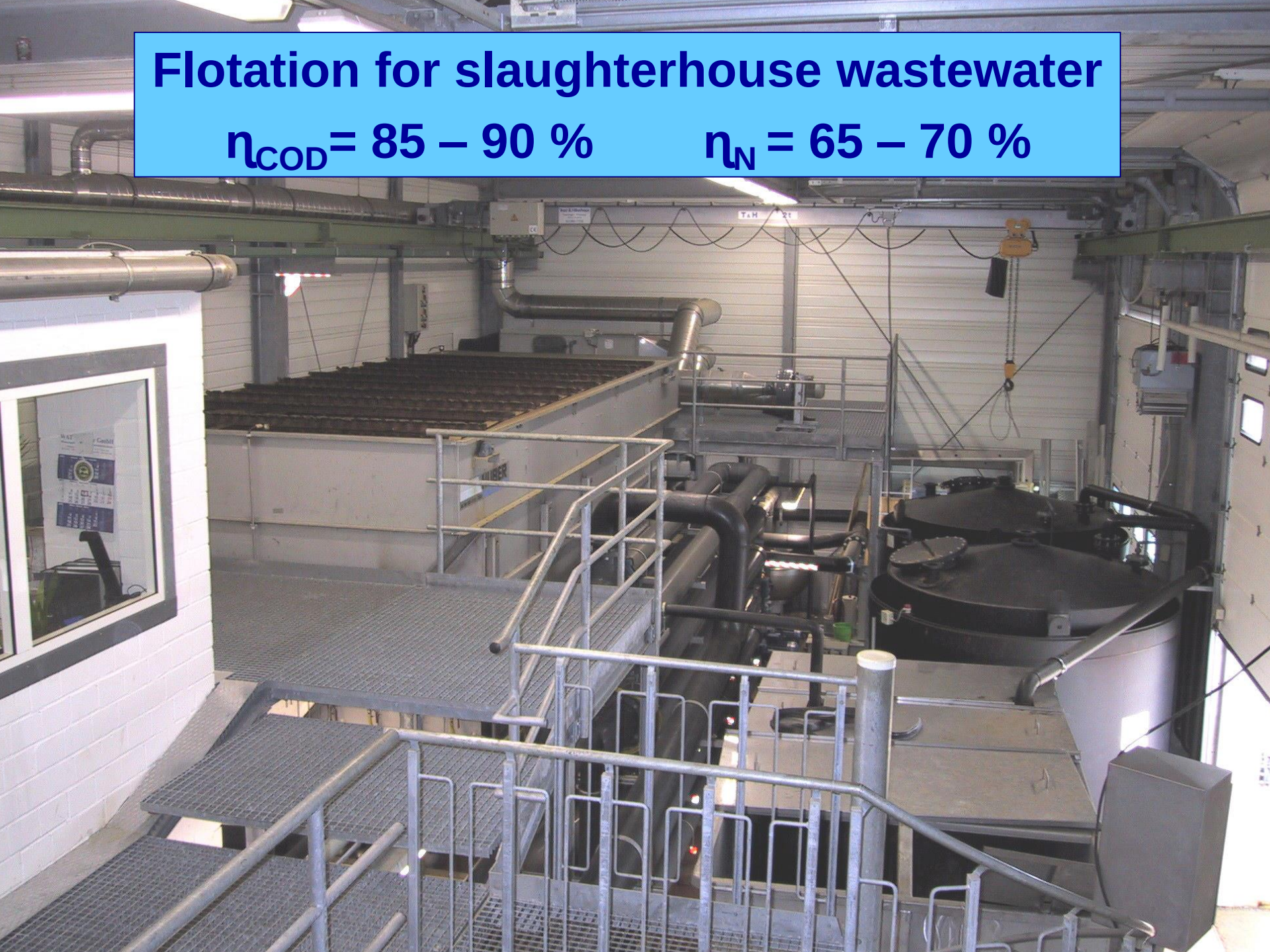


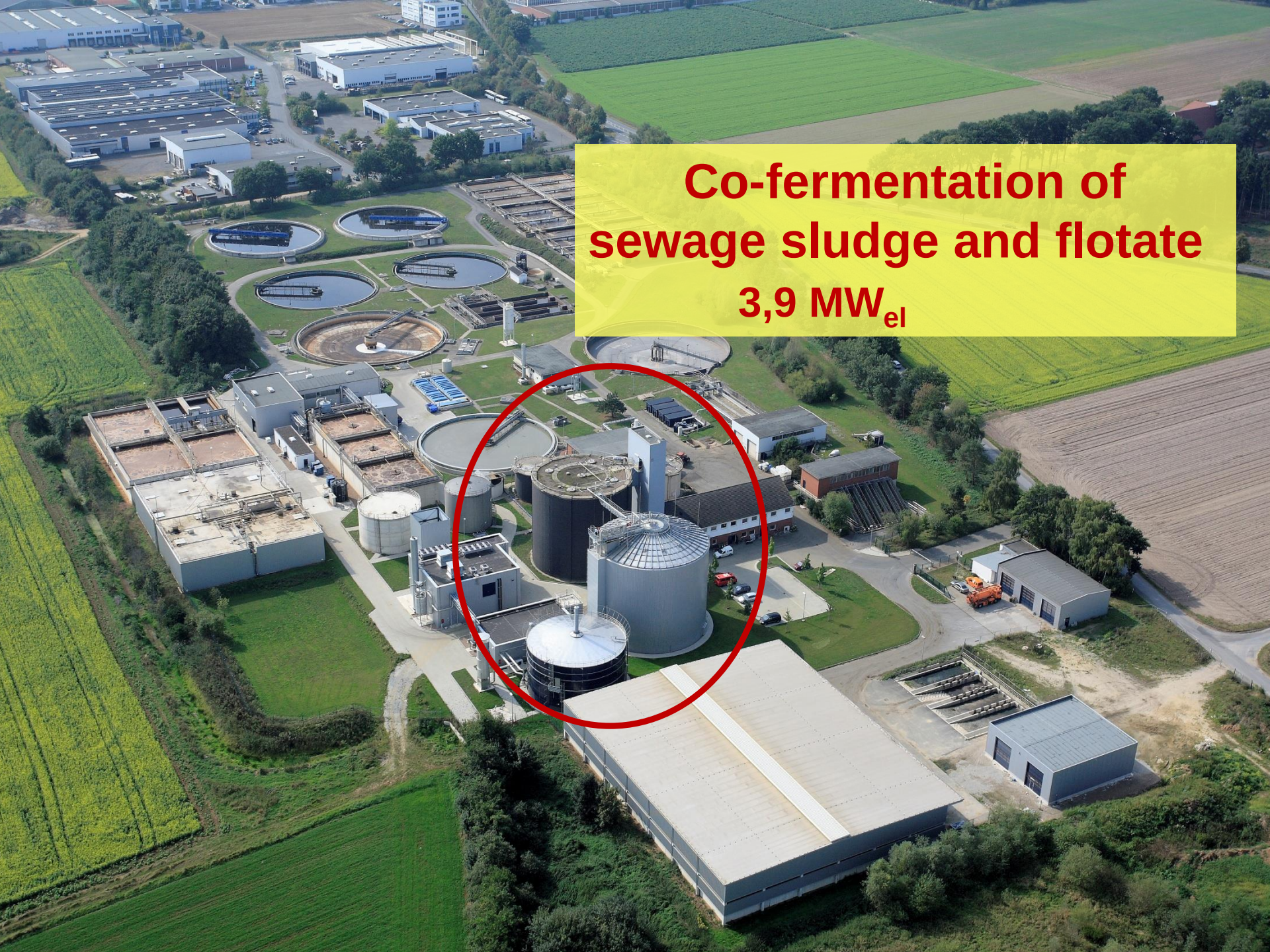

Slaughterhouse
River Ems
Wastewater treatment plant Rheda-Wiedenbrück


Slaughterhouse
Pre-Treatment of the
slaughterhouse waste water
River Ems
Wastewater treatment plant Rheda-Wiedenbrück

Flotation for slaughterhouse wastewater

η_{COD} = 85 – 90 % η_N = 65 – 70 %




Co-fermentation of
sewage sludge and flotate
3,9 MW_{el}

Co-Fermentation of residues from Penicillin-Production and sewage sludge, NCPC China

Duplex-Technology

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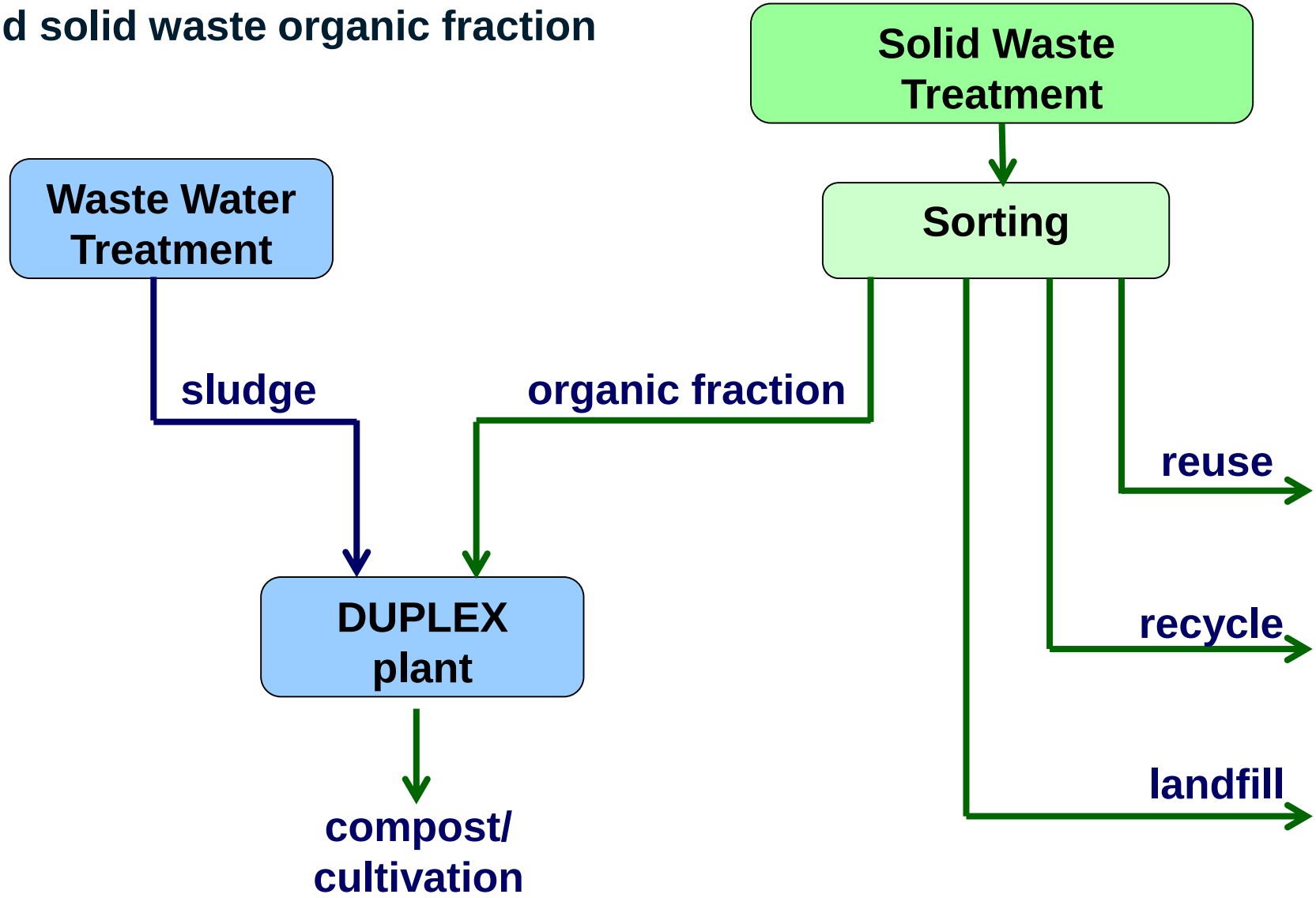
Co-fermentation of Sewage sludge and solid waste organic fraction



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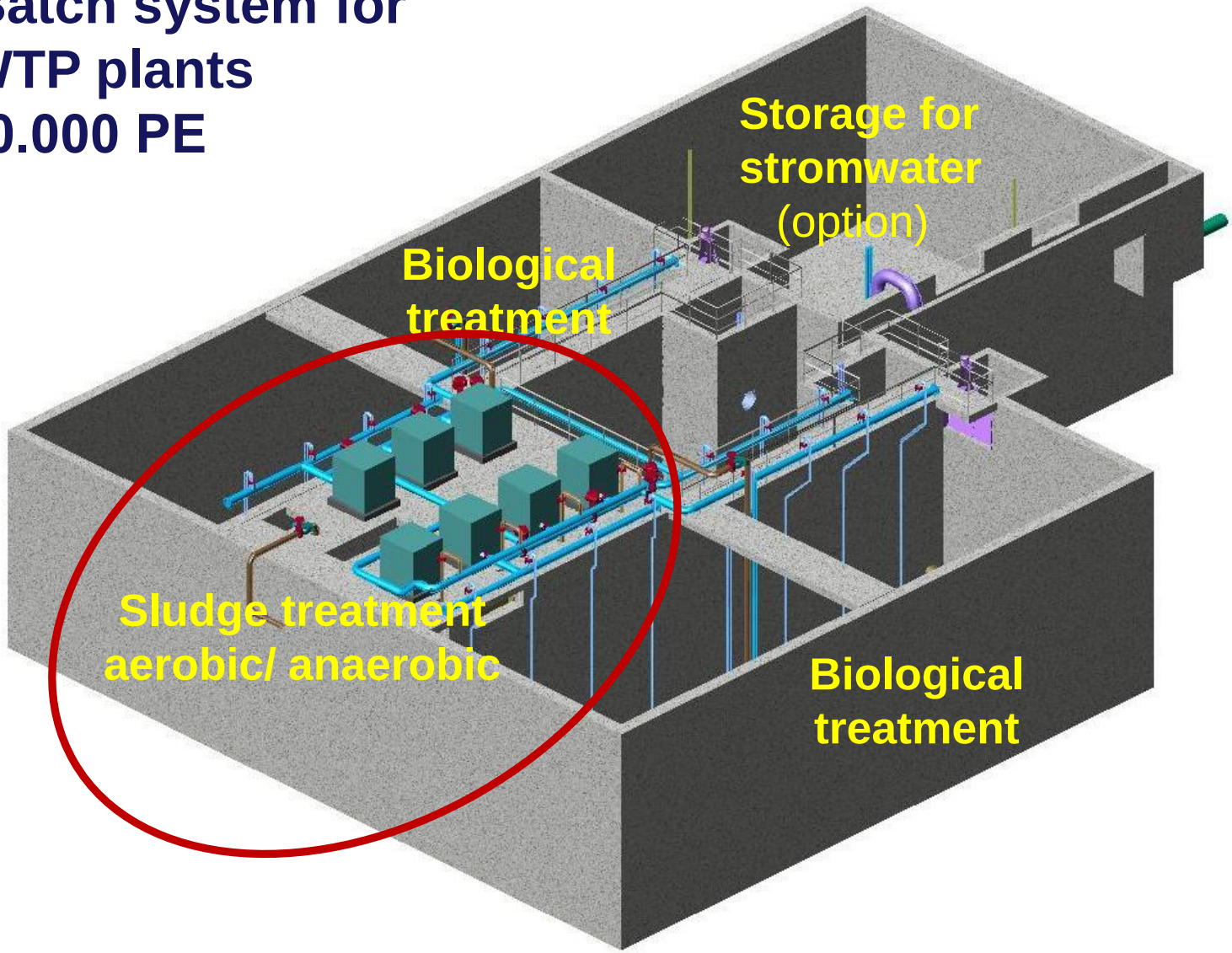
H-Batch system for WWTP plants ≥ 10.000 PE



Dal Lake in Srinagar/ Northern India

… suffers under strong eutrophication

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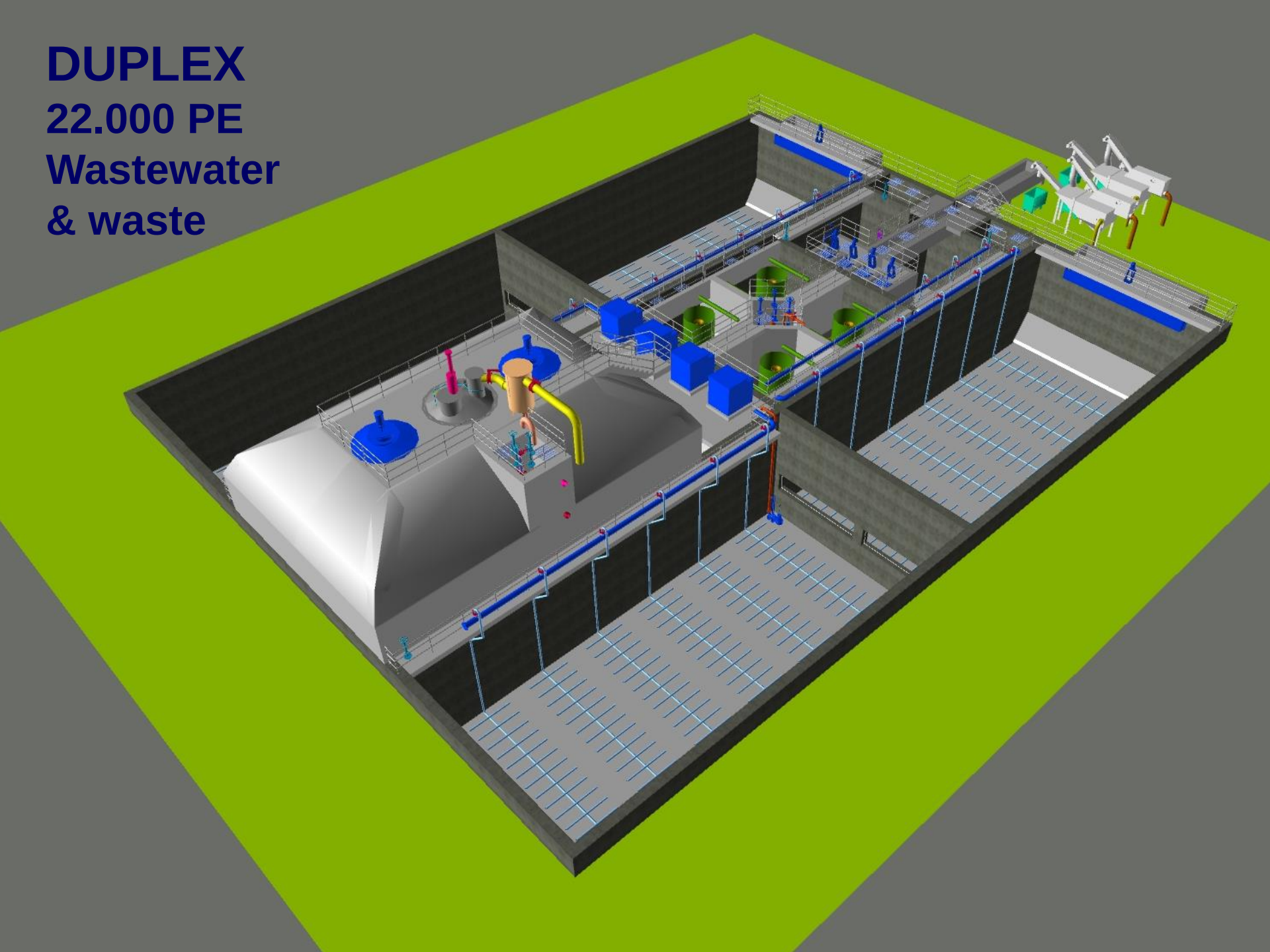
H-Batch-System WWTPs in Srinagar/ India (5.400 m^3/day & 16.100 m^3/day)

DUPLEX
22.000 PE
Wastewater
& waste



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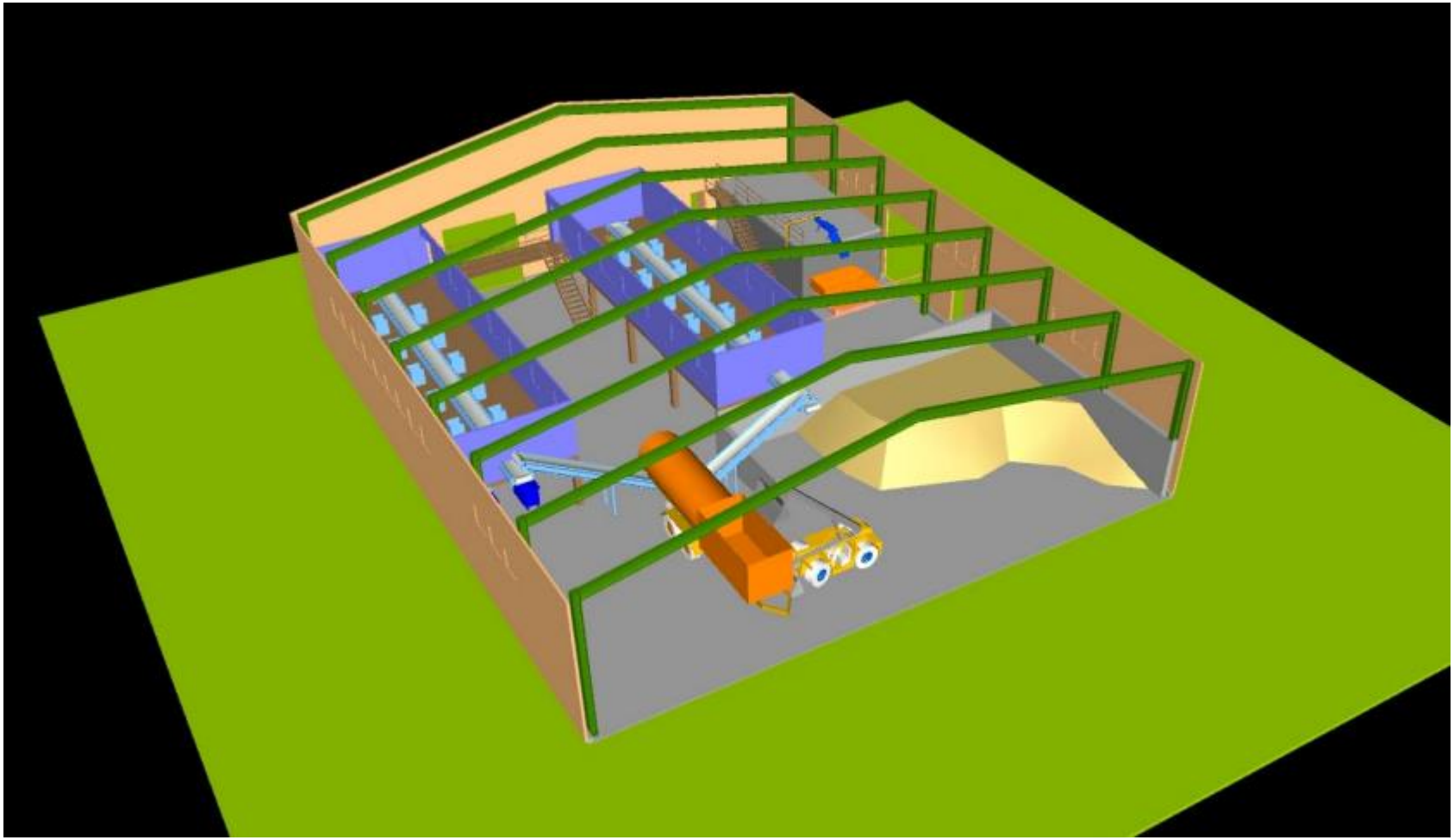
Solid Waste Sorting



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Conditioning of the solid waste required

- Removal of plastics
- Removal of metals
- Removal of sand, glas, stones etc.
- technology is available
- Downsizing for solid waste treatment plants

  < 50.000 PE required

- **generally:**

  Treatment of the seperate collected organics *or*

  Treatment of the complete waste

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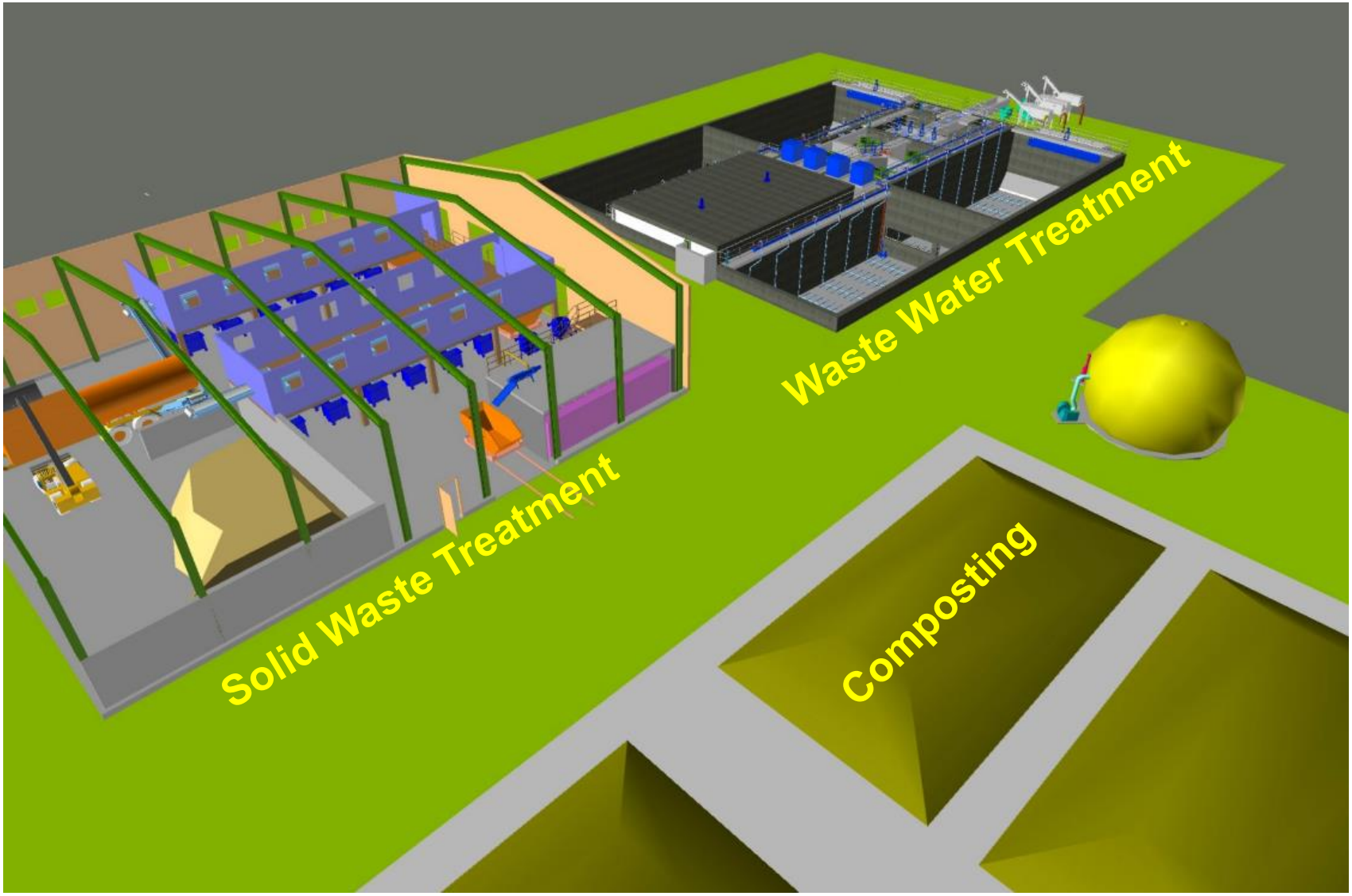

Solid Waste and Wastewater Treatment Center

DUPLEX-system

Capacity 20.000 PE

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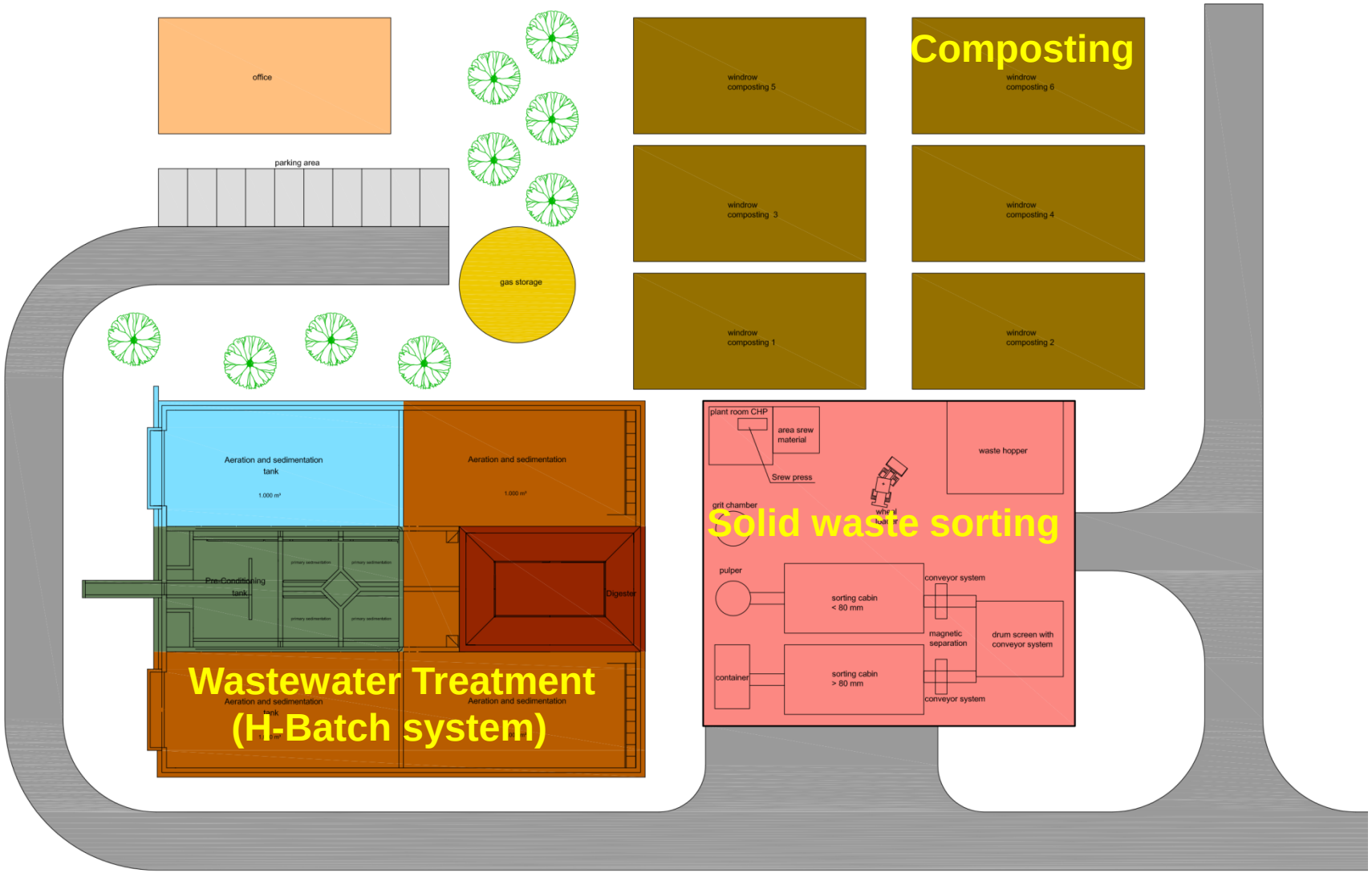

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Conclusion

- **Anaerobic technology has advantages**
  (biogas production, less sludge to be disposed, less space demand)
- **Co-fermentation of organic residues increases the efficiency of the reactor**
  (up to 2,5 instead of 1 m^3 biogas per m^3 reactor)
- **Examples for large scale application are available internationally**
- **Co-fermentation of sewage sludge and organic solid waste fraction can contribute to a sustainable infrustructure**

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Technologies for the nitrogen removal in high concentrated partial streams

Biological technologies

- pre-denitrification or post-denitrification with external carbon source
- nitritation/ denitritation
- deammonification

Stripping of nitrogen

- with steam (product: ammoniumwater)
- with air and acids (product: ammoniumsulfate)

Precipitation

- production of MAP (Magnesium-Ammionium-Phosphate)

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Pilot Plant Nitritation – WWTP Dubai

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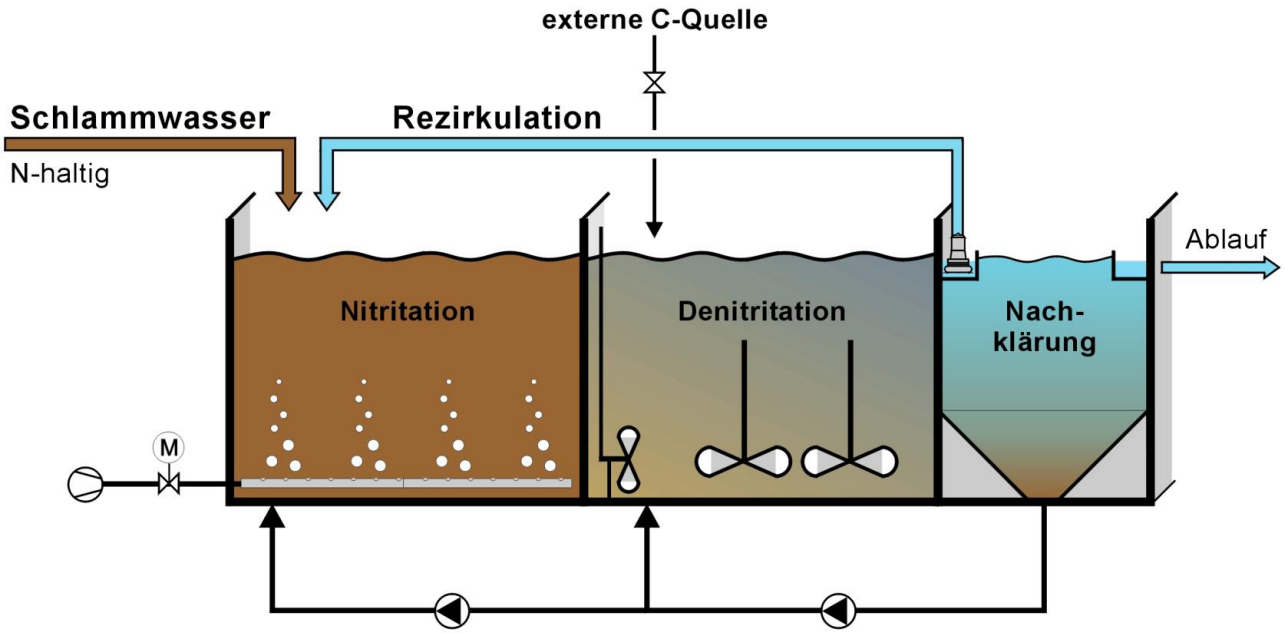
PANDA



Partial **A**ugmented **N**itritation **D**enitritation **A**lkalinityrecovery

Developed by aqua consult Ingenieur GmbH / ISAH, Universität Hannover

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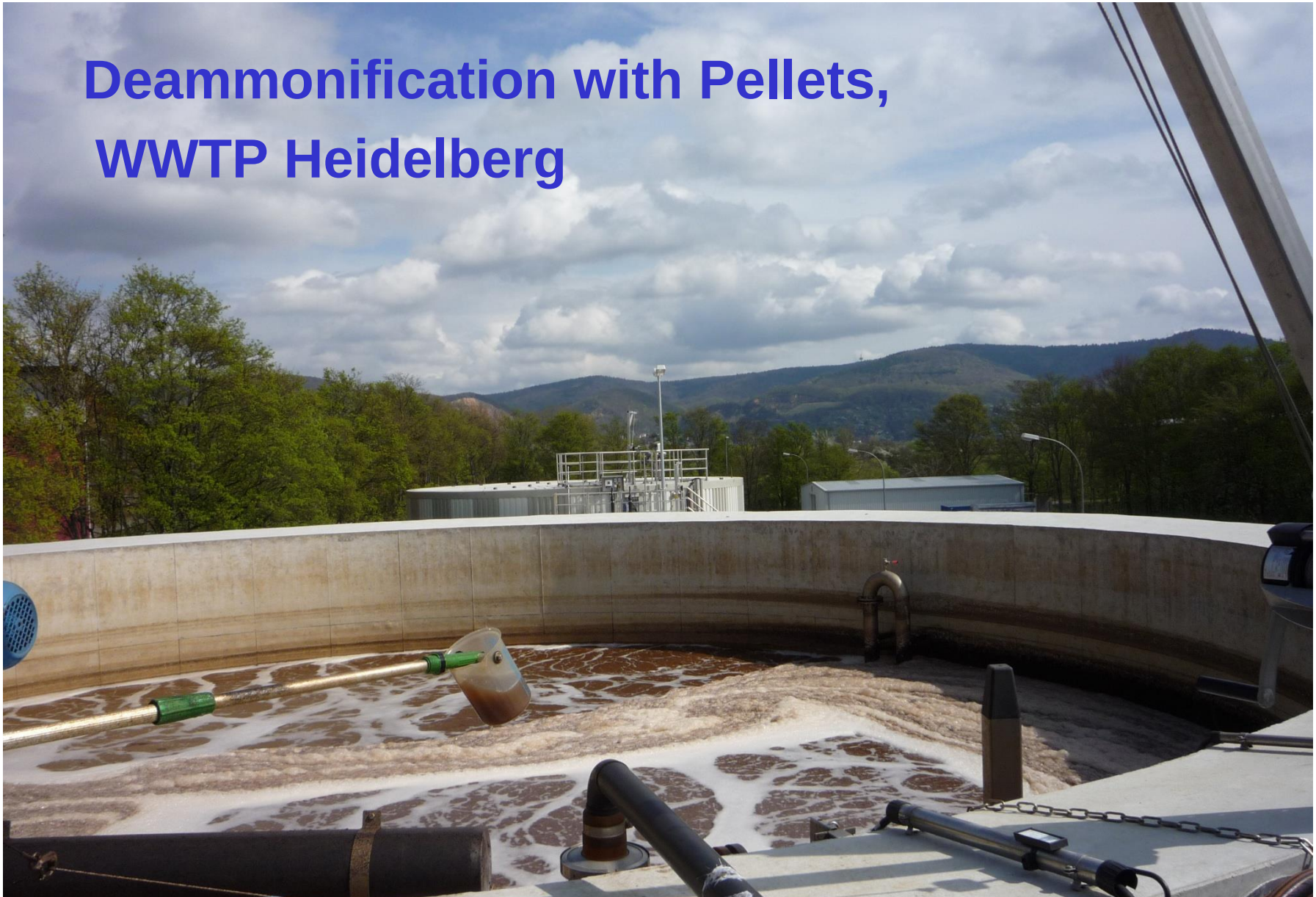
Deammonification with Pellets, WWTP Heidelberg



Biogasplant Pune for food waste

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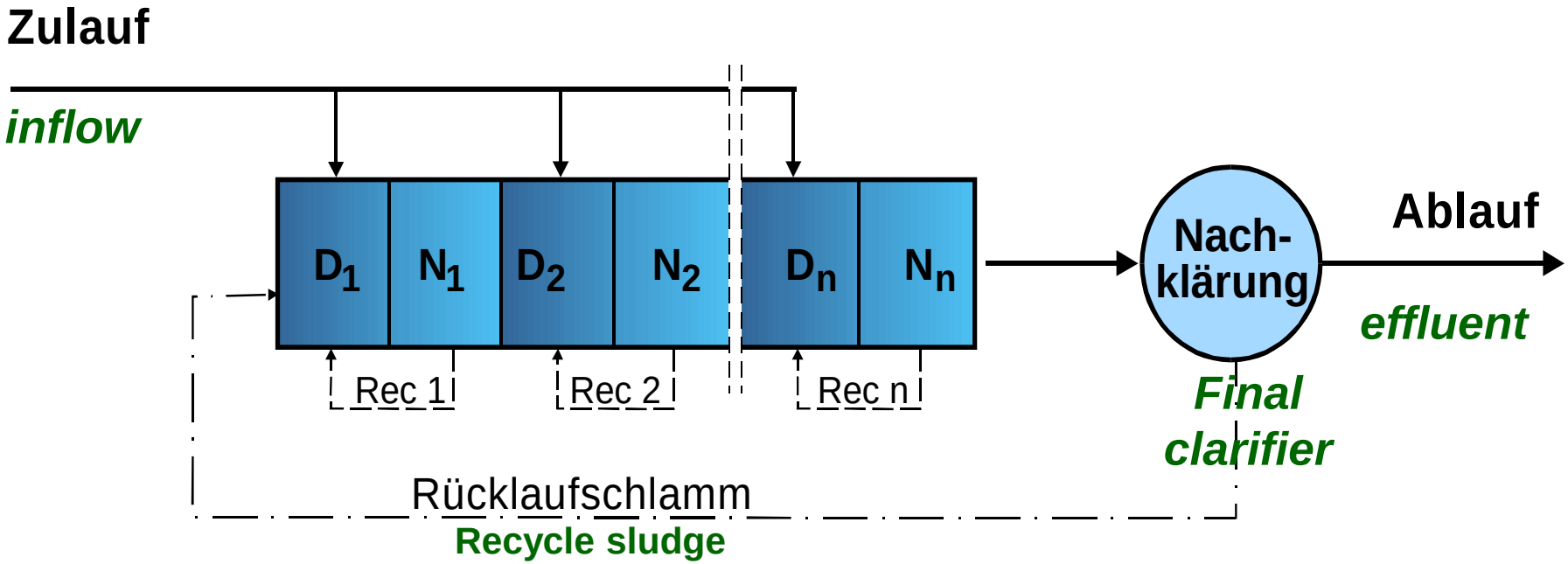
Cascade-denitrification with sepearted inflow to the single compartments



D = Denitrifikation
N = Nitrifikation
Rec = interner Recycle
Index= Nummer der Kassette

D = Denitrification
N = Nitrification
Rec = internal recycle
Index = number of the cascade

WWTP Halberstadt, cascade technology, 60.000 PE

Caskadendenitrification, Kranj 95.000 EW

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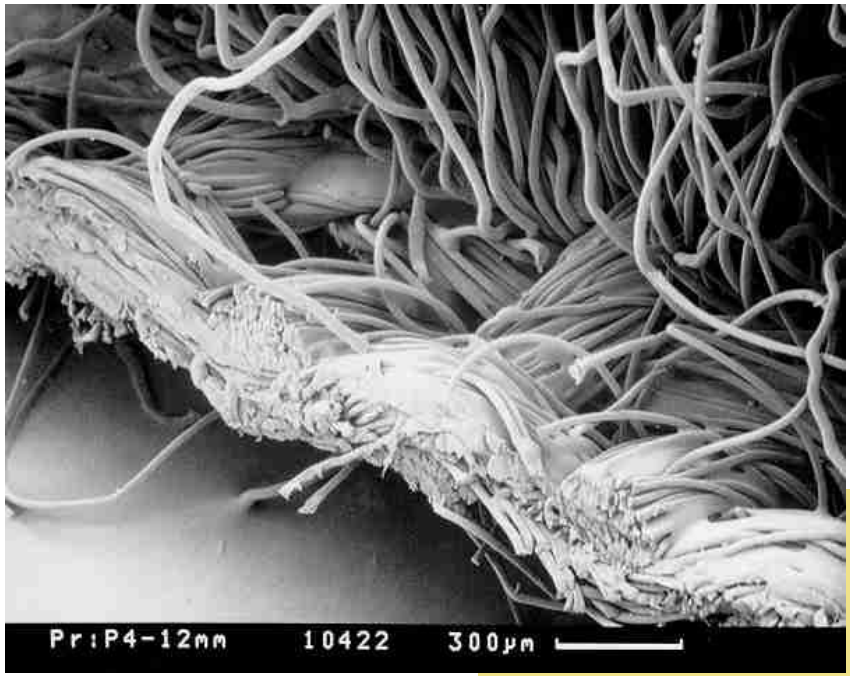

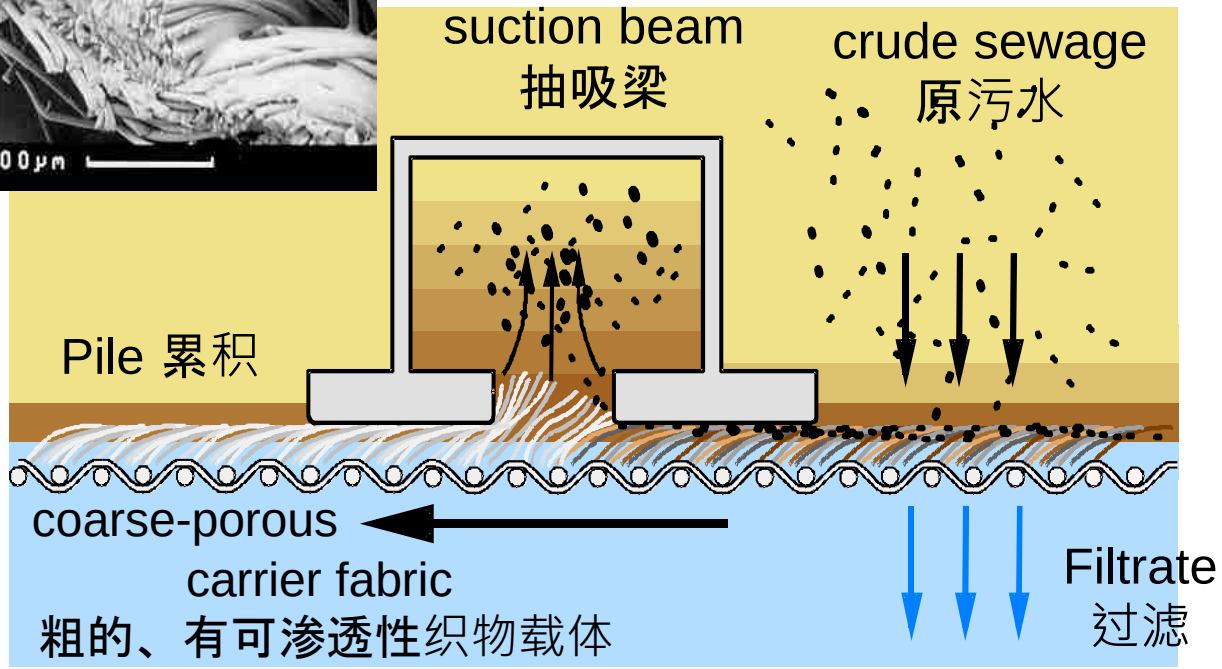

Cloth filtration
Oldenburg/ Germany

KA Kranj/ Slovenia (95.000 PE)
Cloth filtration

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KA Ljubljana/ Slovenien (430.000/ 550.000 EW)

KA Ljubljana/ Slovenien (430.000/ 550.000 EW)

SS_{AS} = 4,3 g/l

Cloth-filtration

Problem:

Pharmaceutical residues in the waste water

Combination

Cloth filtration – Micropollutent Removal

- Cloth-filtration – Ozonation
- Ozonation – Cloth filtration
- Active Carbon – Cloth filtration


Adsorption-
stage

Active carbon treatment stage for the removal of biologically inert COD

Thermal Hydrolysis

+ Biogasproduction

+ Dewaterability

- Sludge load


Sludgedrying
Anaerobic sludge Digestion
+ primary sludge storgae
+ thermal hydrolysis
+ Co-Fermentation
= energetic autark operation

dustrial Wastewater treatment - closed water cycle the fibre board production

истка промышленных сточных вод – закрытый дный цикл на производстве фибролита

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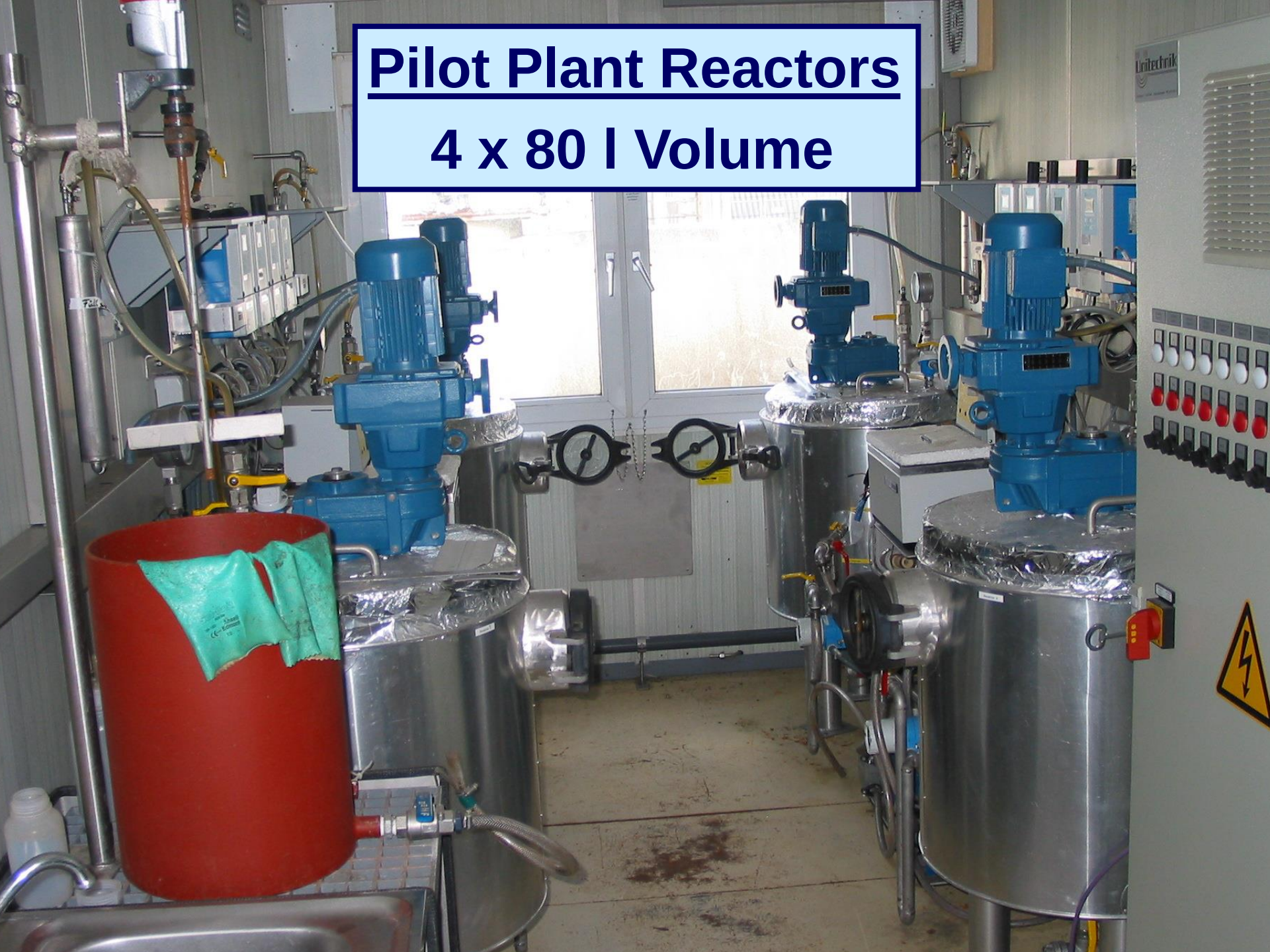
Ingenieur GmbH
Hannover/ Germany

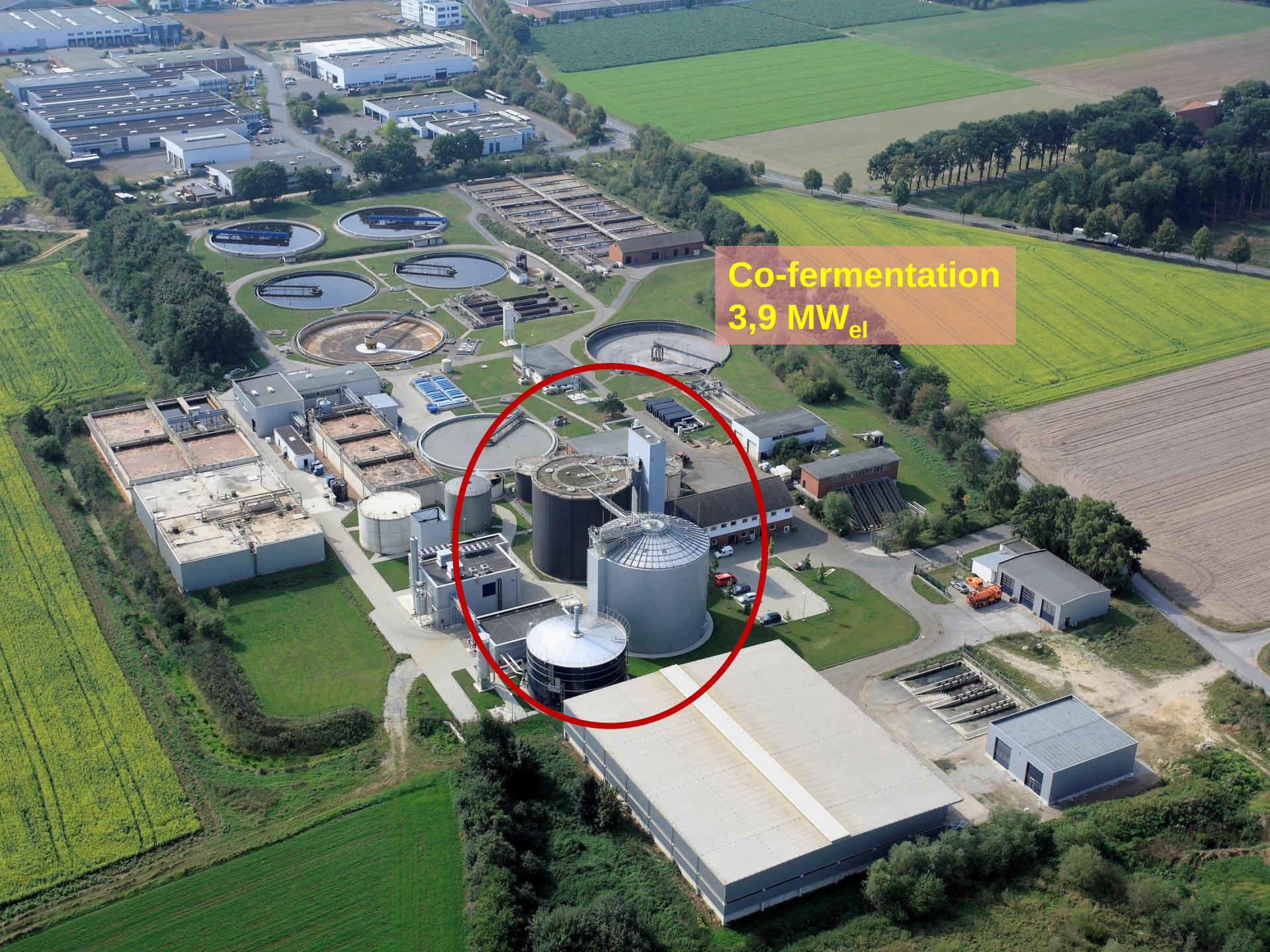
Anaerob Pilot Plant

Pilot Plant Reactors

4 x 80 l Volume




LIEBHERR

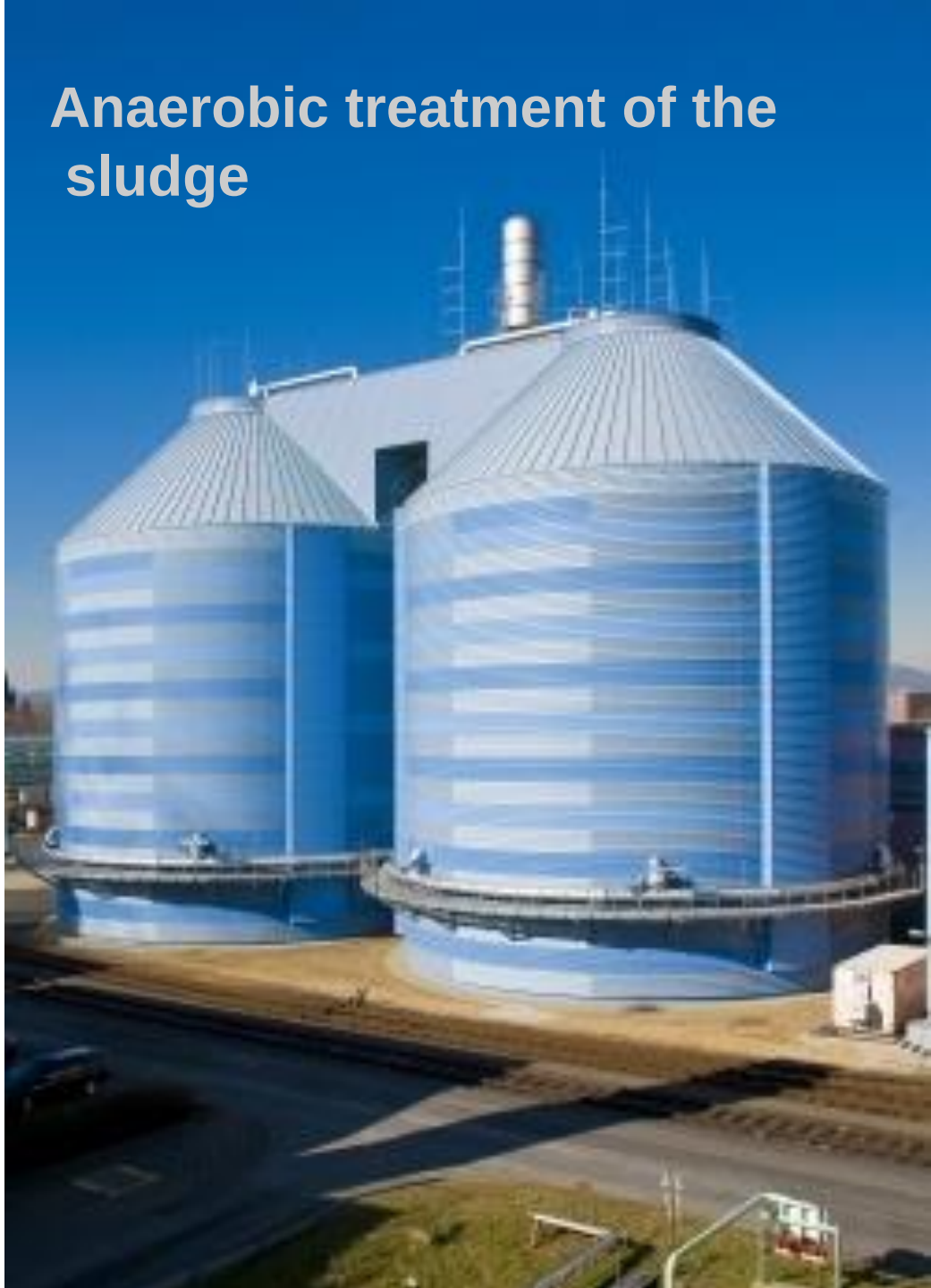

Co-fermentation
3,9 MW_{el}

2 Combined heat power plants,
2 • 1,4 MW_{el}

Industrial Park, Infraserv HOECHST“ in Frankfurt

Aerobic 2-stage Wastewater treatment

Anaerobic treatment of the sludge



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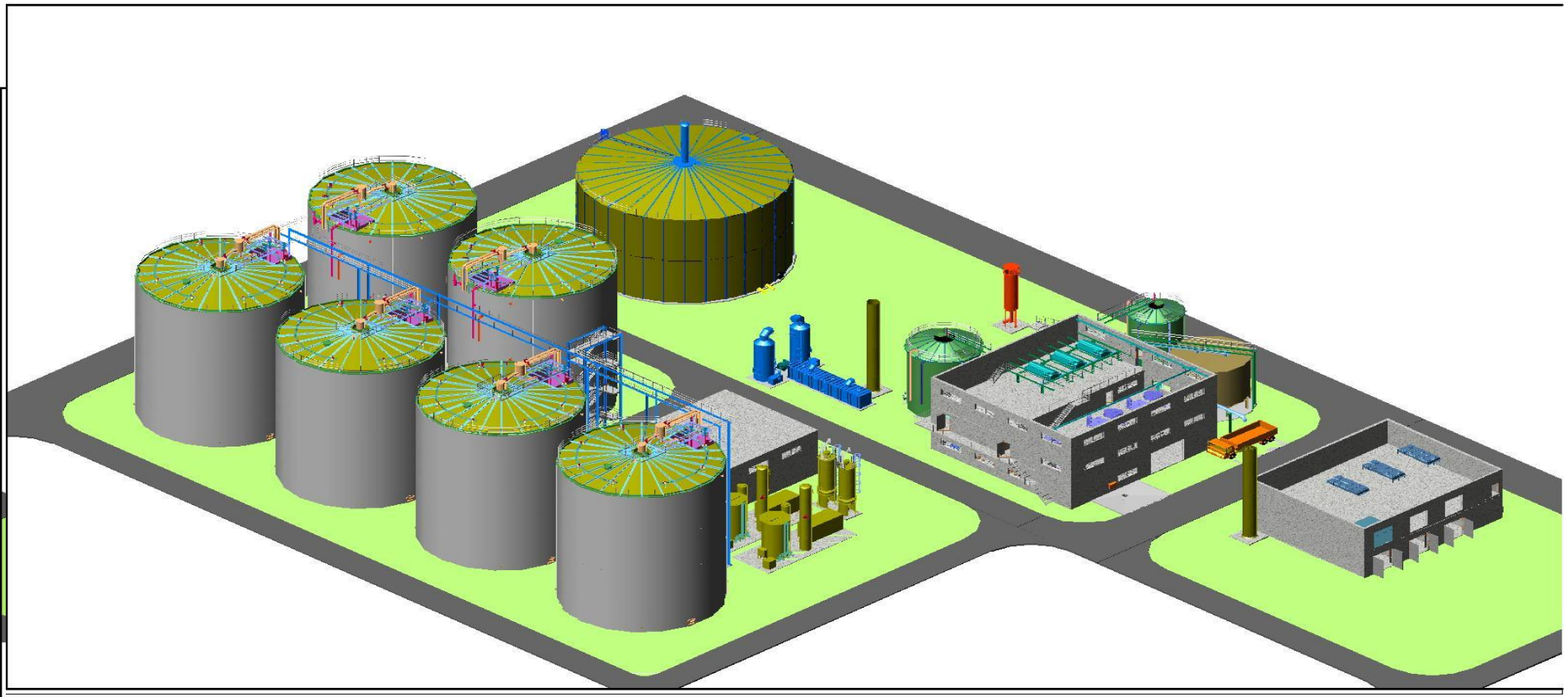
Co-fermentation Project Shijiazhuang 5 Mw_{el}

(surplus sludge, organic production residue)



Digester Construction at NCPC Project


Inspection of the biogasreactor
V= 5.000 m³, Shijiazhuang/ China

Digester Construction at NCPC Project

Anaerobic treat-

ment of the
organic fraction
of the solid waste

- Seperately
- as co-ferment

Environmental protection of the Dal Lake

Waste Water to Cleanwater – Water to Energy – Waste to Energy

The world biggest archimedian screw

Anaerobic treat-

ment of the
organic fraction
of the solid waste

- seperately
- as co-ferment

Mechanical-biological solid waste treatment

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Backloading through nitrogen in the liquid residue

- **high nitrogen loads after the fermentation**

  in the sludgewater from the dewatering facilities (centrifuges, Membrane-presses)

  usually: 600 – 800 mg NH_4-N/l

  with co-fermentation: up to 3.500 mg NH_4-N/l

N-stripping with steam from sludgewater, WWTP Cloppenburg

N-stripping with steam from sludgewater, WWTP Cloppenburg

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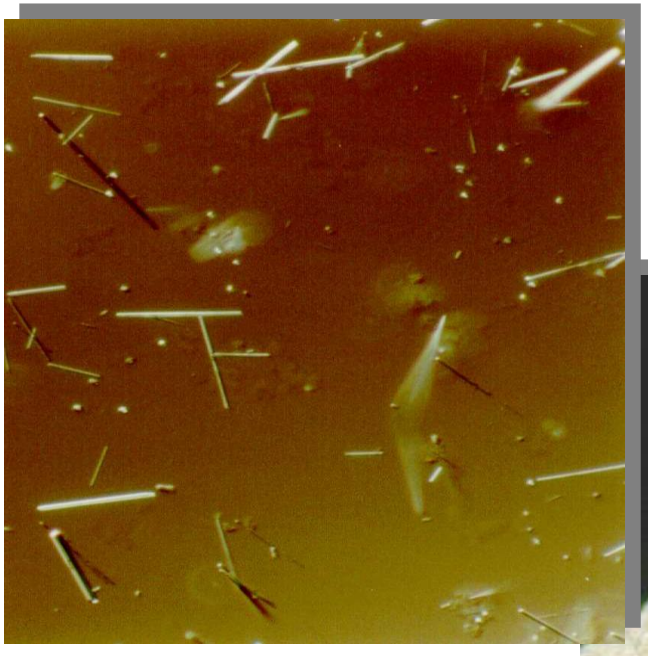
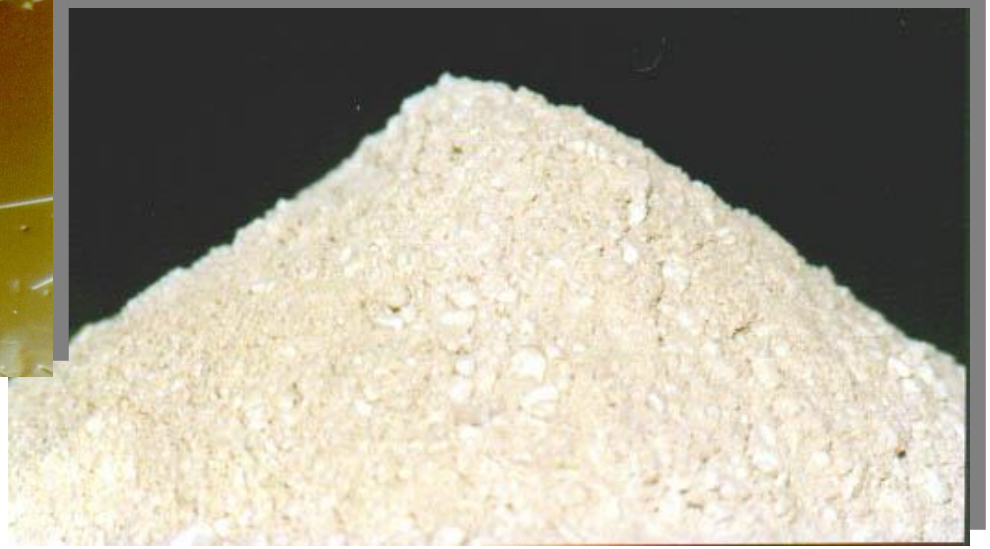


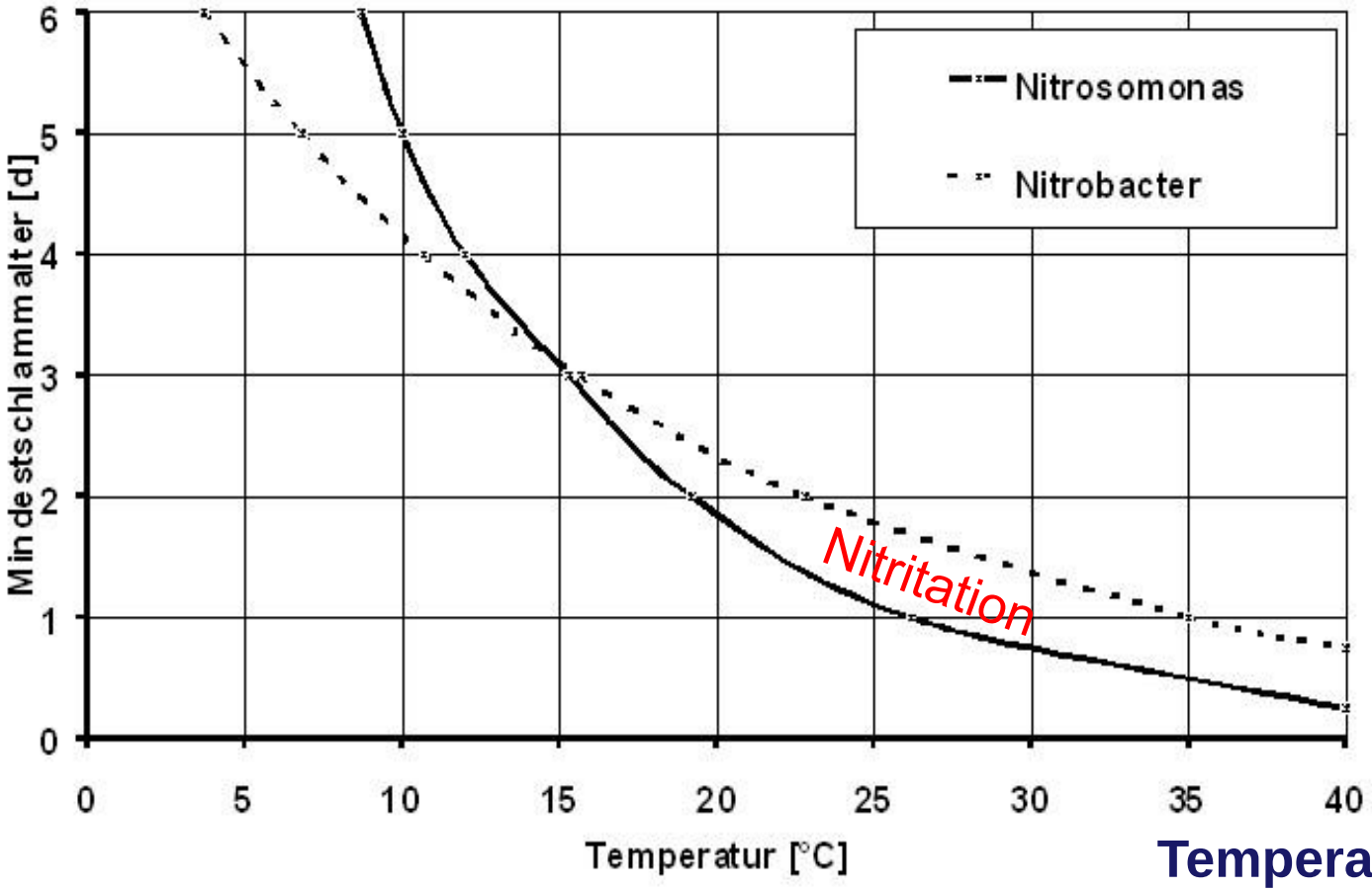
MAP



- Application of the MAP-precipitation for sludgewater is still in the state-of-art phase
- Often used for manure treatment after membrane filtration
- Evtl. higher demands for the sludgewater quality

Growth rates of nitrosomonas and nitrobacter as a function of the temperature according HUNIK (1993)

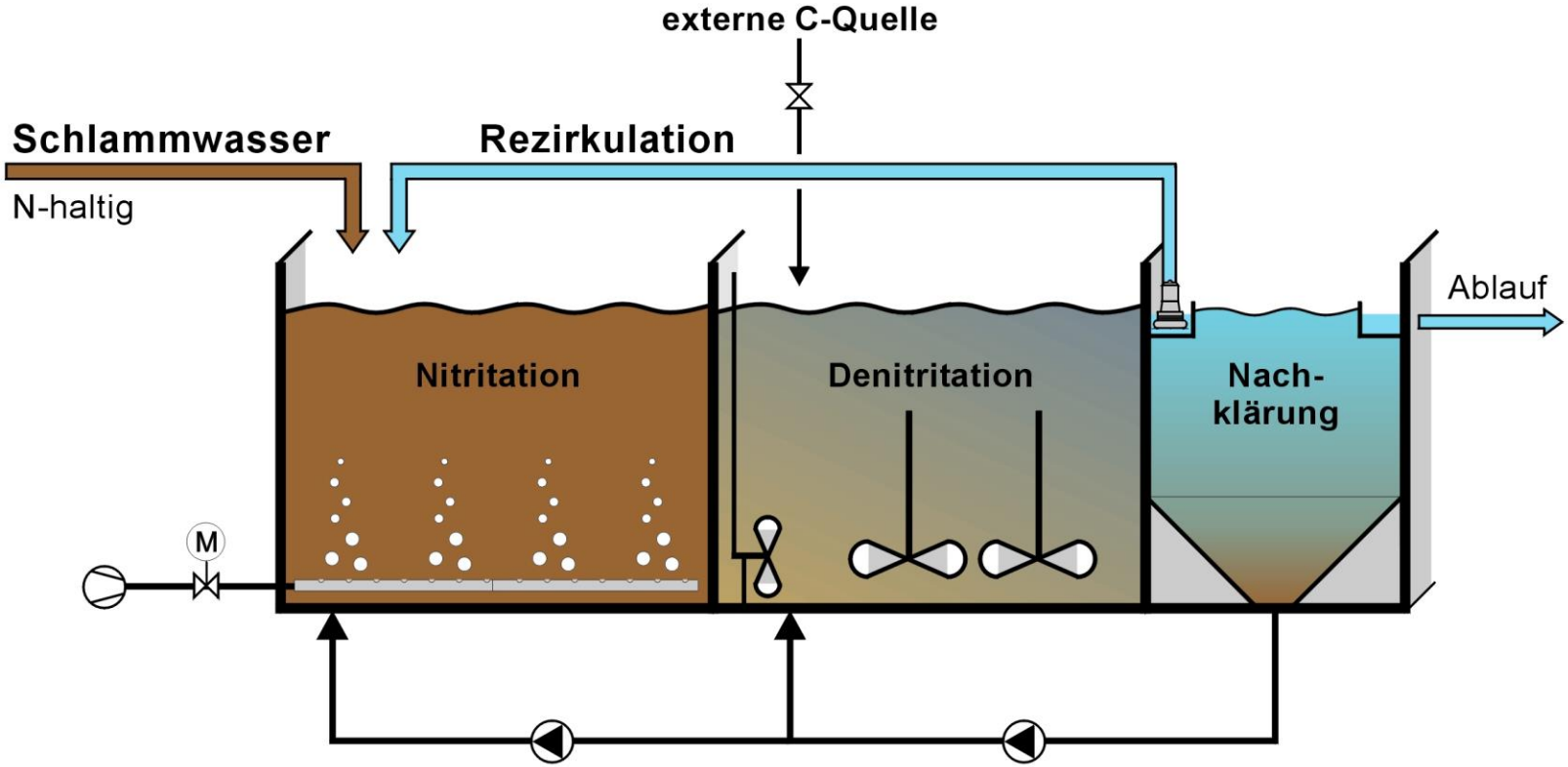
Sludge age [d]



Temperature [°C]


Technical Scale pilot plant for nitritation

PANDA



Partial **A**ugmented **N**itritation **D**enitritation **A**lkalinityrecovery

Developed by aqua consult Ingenieur GmbH / ISAH, Universität Hannover

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Components for the co-fermentation of flotate at the WWTP Rheda-Wiedenbrück

Sludgewater treatment (PANDA)

CHP-plant 2,8 MW_{el}

Anaerobic digester
5.000 m^3 (exist.)
6.500 m^3

Sludgewater treatment Rheda-Wiedenbrück (PANDA)

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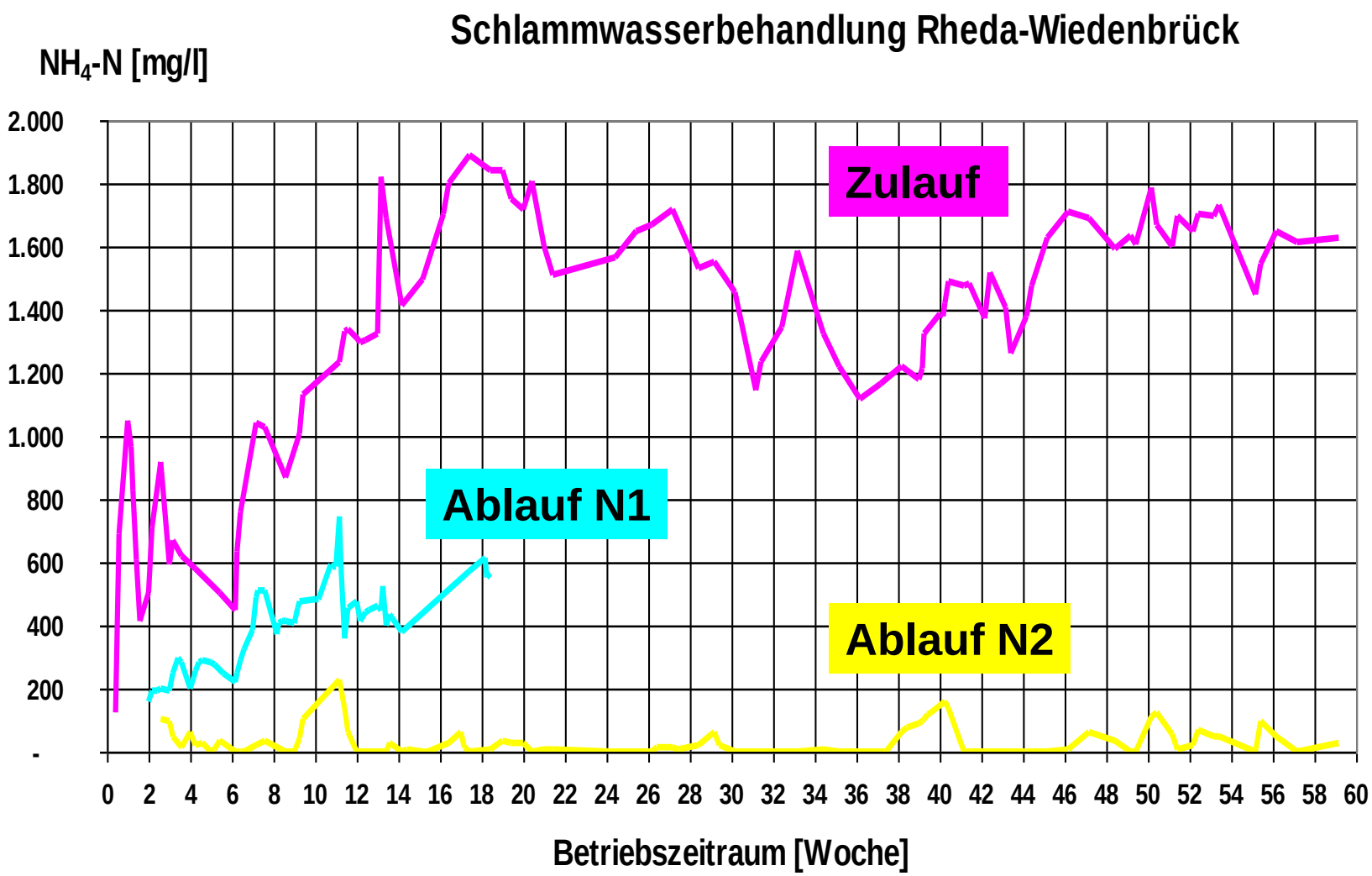

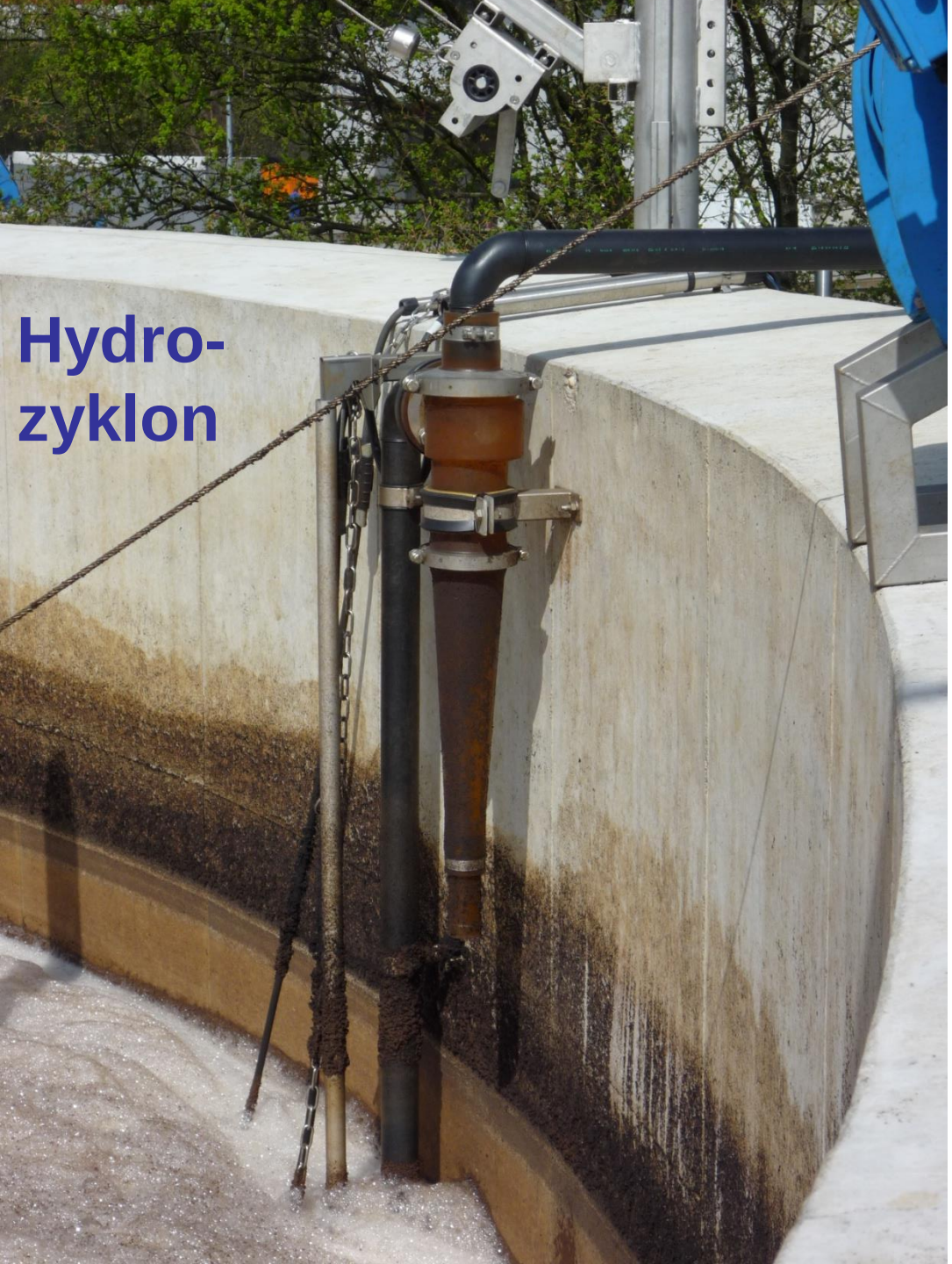

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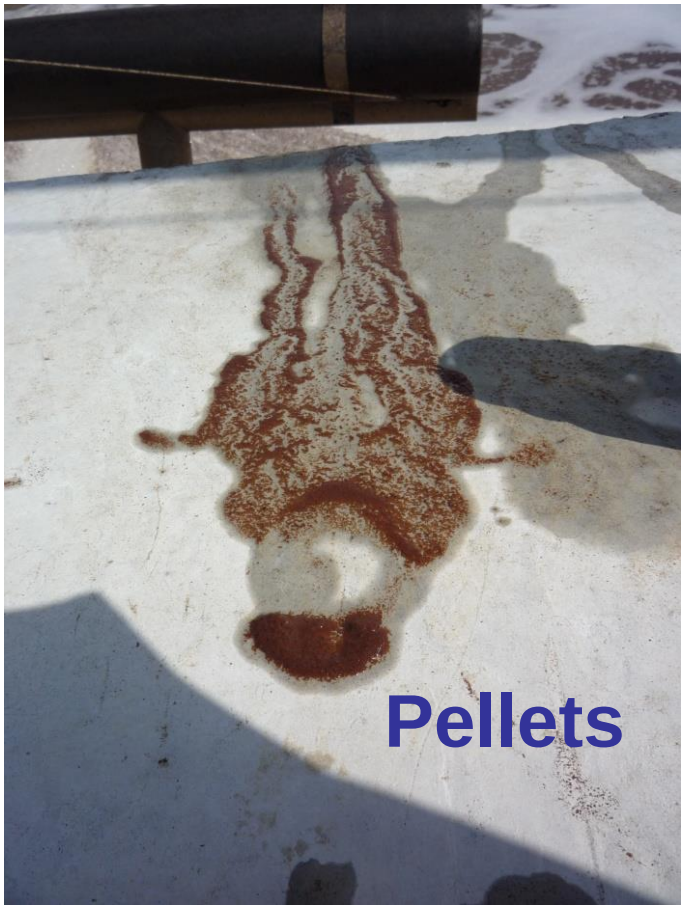


Deammonification
is an proved energy saving
technology for N-removal

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Flotate as valuable energy source

Флотант как ценный источник энергии

Pre-treatment after flotation

Предварительная обработка после флотации

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Refined compost as a valuable product in plastic bags ready for selling